Small Business Innovation Research/Small Business Tech Transfer

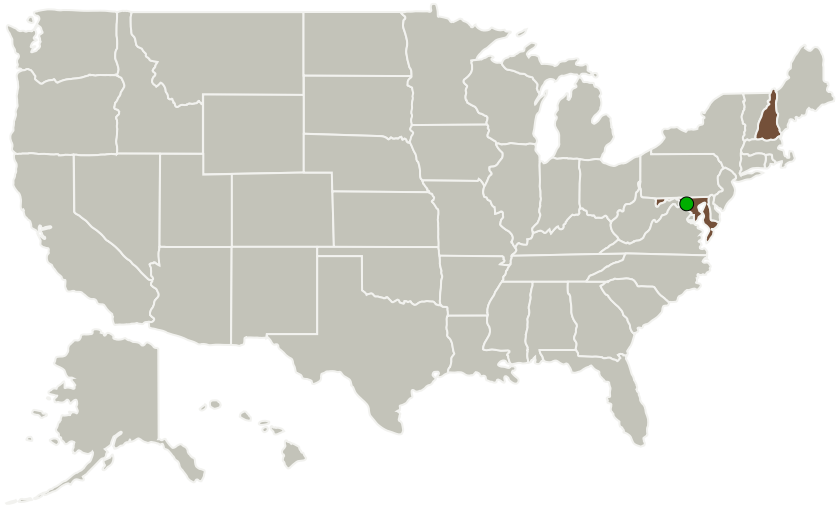
A 10 K Multistage Cryocooler with Very Low Vibration, Phase I

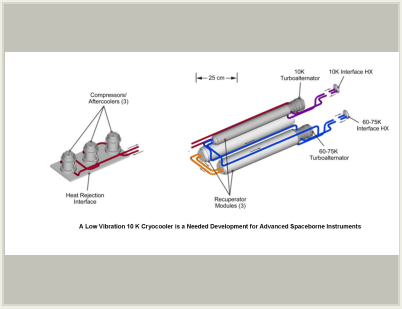
Completed Technology Project (2016 - 2016)

Project Introduction

Advanced space-borne instruments require cooling at temperatures of 10 K and below. These coolers will be used for as upper-stage cryocoolers for sub-Kelvin cryocoolers and instruments or the primary cooler for electro-optical instruments. Cooling loads for these detectors will range from 0.25 W to 1.0 W at the primary load site, with additional loads at higher temperatures for other subsystems. Due to jitter requirements, a cryocooler with very low vibration is required. In addition, a multistage cooler, capable of providing refrigeration at more than one temperature simultaneously, can provide the greatest system efficiency and lowest mass. Turbomachine-based Brayton cryocoolers are ideal candidates for these applications because they are highly efficient, lightweight, vibration-free, multistage compatible, and have long maintenance-free lifetimes. Creare has developed state-of-the-art components needed to create turbo-Brayton cryocoolers for these missions. During the current program, we propose to develop and demonstrate a two-stage cryocooler that provides refrigeration at 10 K, with additional cooling at 60 to 70 K. On the Phase I project, we will optimize the performance of an existing cryocooler for a particular NASA mission class and measure its performance. During the Phase II project, we plan to build an advanced cold-stage turboalternator, integrate it with the cryocooler and measure its performance at cold load temperatures as low as 10 K. We will use the test results to develop a design for a fully optimized, flight cryocooler.

Primary U.S. Work Locations and Key Partners





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Completed Technology Project (2016 - 2016)

Organizations Performing Work	Role	Type	Location
Creare LLC	Lead Organization	Industry	Hanover, New Hampshire
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Maryland	New Hampshire

Project Transitions

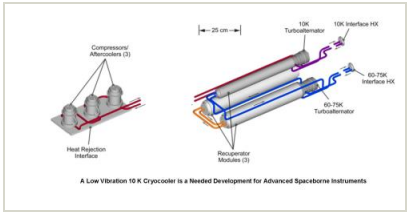
June 2016: Project Start

December 2016: Closed out

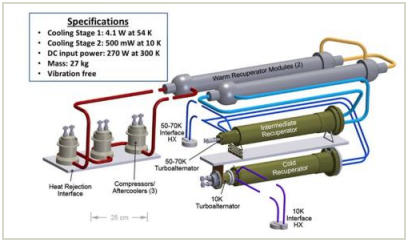
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139616)*

Images



Briefing Chart Image
A 10 K Multistage Cryocooler with Very Low Vibration, Phase I *(https://techport.nasa.gov/image/136954)*



Final Summary Chart Image
A 10 K Multistage Cryocooler with Very Low Vibration, Phase I Project Image *(https://techport.nasa.gov/image/136523)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Creare LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Mark Zagarola

Co-Investigator:
Mark Zagarola

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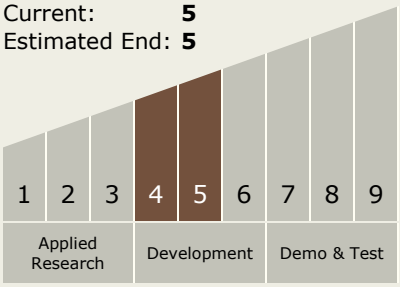
Completed Technology Project (2016 - 2016)

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.6 Cryogenic / Thermal

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System